3.2 Medical Requirements Overview

TABLE 3.2: MEDICAL REQUIREMENTS OVERVIEW

MRID# and Title:	MR005L In-flight Radiation Monitoring with Tissue Equivalent Proportional Counter (TEPC) for Long Duration Flights
Sponsor:	Medical Operations
Discipline:	Radiation
Category:	Medical Requirements
References:	SSP 50260 ISS Medical Operations Requirements Document
Purpose/Objectives:	The purpose of the activity is to collect radiation environment data that will document crew exposure to radiation, perform risk assessment, and manage crew exposures during flight, especially during radiation contingencies. The TEPC collects the surrogate linear energy (y) data for the required linear energy transfer (LET) data and the absorbed dose. The Radiation Health Officer (RHO) will apply physical corrections to convert linear energy (y) spectra obtained with the TEPC to LET –spectra for use in determining crew exposures. These corrections must account for the impact parameter distribution, energy straggling, delta-ray effects, and wall effects from both delta-rays and nuclear reactions.
Measurement Parameters:	Radiation exposures at the tissue-cell level y-spectra data.
Deliverables:	Characterization of the radiation environment for updating exposure records for occupational health risk assessments. Real-time data for use during radiation contingencies. Onboard crew alarm for contingency radiation events
Flight Duration:	≥ 30 days
Number of Flights:	All flights
Number and Type of Crew Members Required:	Designated crewmembers will be assigned as operators. All U.S. crewmembers' medical records will be updated based on TEPC data.
Other Flight Characteristics:	N/A

3.3 Preflight Training

TABLE 3.3: PREFLIGHT TRAINING

Preflight Training Activity Description:	Training will be covered in the following lesson: Radiation Operations Training classes will introduce the radiation hardware, procedures and review the radiation environment in space. The location and function of each piece of hardware is detailed. Hands on training will also be provided. Long-duration crewmembers will be trained to initially deploy and to download data from the TEPC to the SSC. Relocation and malfunction procedures will be covered.			
Schedule:	**Duration:**	**Schedule:**	**Flexibility:**	**Personnel Required:**
	Radiation Operations 45 min.	L-19 months	N/A	Crewmember/Instructors
Ground Support Requirements Hardware/Software	**Preflight Hardware:**	**Preflight Software:**	**Test Location:**	
	Tissue Equivalent Proportional Counter (TEPC)	TEPC Software on SSC	U.S.	
Training Facilities	**Minimum Room Dimensions:**	**Number of Electrical Outlets:**	**Temperature Requirements:**	**Special Lighting:**
	8' x 10'	2	Ambient	N/A
	Hot or Cold Running Water:	**Privacy Requirements:**	**Other:**	
	N/A	N/A	1 Table, 4-6 Chairs	
Constraints/Special Requirements:	N/A			
Launch Delay Requirements:	Training will be repeated if requested by the crewmember.			
Notes:	N/A			

3.4 Preflight Activities - None

3.5 In-Flight Activities

TABLE 3.5.1: IN-FLIGHT ACTIVITIES

<table>
<tr><td>In-Flight Activity
Description:</td><td>The TEPC will operate continuously to provide radiation measurements of tissue dose and dose equivalent. The TEPC will be relocated periodically throughout the habitable modules of the station to analyze the internal radiation environment. Space Radiation Analysis Group (SRAG) will define a relocation plan to determine how long and at which locations the TEPC will be deployed. Deployment sites will be within the cable reach of the CHeCS Power/Data ports. Measured spectra will be telemetered approximately weekly on demand.

LET spectra data shall be used to provide an estimate of average quality factor for the mission</td></tr>
<tr><td>Schedule:</td><td>
<table>
<tr><th>Activity</th><th>Duration</th><th>Schedule</th><th>Personnel Required</th></tr>
<tr><td>TEPC Initial Deployment</td><td>45 min.</td><td>Crew will deploy once in orbit</td><td>1 ISS crewmember</td></tr>
<tr><td>TEPC Relocate</td><td>10-30 min. depending on new location</td><td>Once every 4 weeks +/-1 week</td><td>1 ISS crewmember</td></tr>
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</td></tr>
<tr><td>Procedures:</td><td>All in-flight procedures are developed in-house and contained within the System Operations Data file (SODF) MedOps book.
TEPC Initial Deployment TEPC Malfunction TEPC Call-down
TEPC Alarm TEPC Relocate TEPC Fuse Changeout</td></tr>
<tr><td>Constraints / Special Requirements:</td><td>Scrub turnaround = N/A
The TEPC will be secured within the designated modules via Velcro or seat track interface.
The TEPC has a local audible alarm that provides information to the crew that the dose rate is high and should be monitored during radiation events where high levels are expected. The TEPC alarm is also tied into the station caution and warning system (class 3 alarm).
New location must not impede rapid egress or block access to any rack.</td></tr>
<tr><td>Photo / TV Requirements:</td><td>Photo of TEPC Spectrometer and Detector is required when TEPC is relocated to a new area, or when the crew is unable to deploy as instructed due to unforeseen obstacles (e.g. Stowage configuration changes). Photo is necessary to document the position and orientation of the detector head, surroundings of the TEPC, and to ensure the Detector is not shielded more than expected.</td></tr>
<tr><td>Cold Stowage Requirements:</td><td>N/A</td></tr>
<tr><td>Mission Extension Requirements:</td><td>N/A</td></tr>
<tr><td>Landing Wave-Off Requirements:</td><td>N/A</td></tr>
<tr><td>Data Delivery</td><td>Detailed TEPC spectra shall be downlinked weekly for analysis. Data files are downlinked to the Enhanced Huntsville Operations Support Center System (EHS) Web. A weekly report is provided to the flight surgeon via flight note within 7-14 days following receipt of data.
If the capability to command the TEPC from MCC-H is lost, , it is advisable that TEPC data be transferred to the SSC approximately once per month to prevent data loss due to the possibility of new data recording over previous data.

A comprehensive report will be delivered to the Crew Surgeon and Data Archivist approximately 90 days postflight, contingent upon the completion of the Biodosimetry results, which is a part of the final report..</td></tr>
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TABLE 3.5.2: IN-FLIGHT HARDWARE

Hardware/Software Name
Tissue Equivalent Proportional Counter (TEPC) Assembly

3.6 Postflight Activities

TABLE 3.6: POSTFLIGHT ACTIVITIES

Postflight Activity Description:	Submittal of final mission expedition report.
Constraints/Special Requirements:	N/A
Early Destow / Early Return:	N/A
Notes:	Crewmember radiation exposure from each mission and their accumulated radiation exposure will be recorded in crewmembers' medical records and will also be used for occupational health risk assessment.
Data Delivery	A comprehensive report will be delivered to the Crew Surgeon and Data Archivist approximately 90 days postflight, contingent upon the completion of the Biodosimetry results, which is a part of the final report.
Mission Summary Report:	Approx. R+90 days
Data Archives:	Approx. R+90 days

3.7 Summary Schedule

TABLE 3.7: SUMMARY SCHEDULE

ACTIVITY	DURATION	SCHEDULE	PERSONNEL REQUIRED	CONSTRAINTS
Preflight Training:				
Radiation Operations	45 min.	L-19 months	Crewmembers/Instructors	None
Preflight: N/A				
In-Flight Activity:				
TEPC Initial Deployment	45 min.	Crew will deploy once in orbit	1 ISS crewmember	None
TEPC Relocate	10-30 min. depending on new location	Once every 4 weeks +/-1 week	1 ISS crewmember	New location must not impede rapid egress or block access to any rack.
Photo of TEPC Relocation	5-10 min	When relocated to new area or if the crewmember is unable to deploy the TEPC as instructed due to stowage issues or other hindrances.	Crewmember	Photo should include surrounding area of relocation
Postflight: N/A				
Postflight Debrief:				
Debrief	No extra time	~R+30 days	Crewmembers/Radiation Team	Included as part of the Med Ops overall debrief.